



TAXONOMY OF *BEANIA* Johnston, 1840 (BRYOZOA, FLUSTRINA) FROM ARRAIAL DO CABO, RIO DE JANEIRO STATE, BRAZIL ¹

(With 4 figures)

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ABSTRACT: Five species of *Beania* Johnston, 1840 (Bryozoa: Flustrina) were previously reported from Brazil, but only one, identified incorrectly in the literature as *B. intermedia* (Hincks, 1881), was reported from Rio de Janeiro State. In this study, we describe three species of *Beania* from Arraial do Cabo, Rio de Janeiro State: *Beania klugei* Cook, 1968 (= *B. intermedia sensu* Marcus, 1937), *Beania mirabilis* Johnston, 1840, and *Beania maxilladentata* sp.nov. *Beania mirabilis* is a new record for Rio de Janeiro State. It is characterized by a long basal cauda, approximately as long as the rest of the autozoid, two pairs of oral spines, and usually five pairs of short marginal spines overarching the frontal membrane. *Beania klugei* is characterized by the absence of both oral and marginal spines, and by its large autozooids and small avicularia. *Beania maxilladentata* sp.nov. has autozooids with up to three pairs of marginal spines directed outwards; the distal end of the autozoid never overlaps the proximal end of the next zooid in series; and the avicularia are as long as wide, with mandibles with accessory tips. Our study raises the number of species of *Beania* known in Rio de Janeiro State from one to three, and along the Brazilian coast from five to six.

Key words: Bryozoa. *Beania mirabilis*. *Beania klugei*. *Beania maxilladentata* sp.nov. South Atlantic.

RESUMO: Taxonomia de *Beania* (Bryozoa, Flustrina) de Arraial do Cabo, Estado do Rio de Janeiro, Brasil. Cinco espécies de *Beania* Johnston, 1840 (Bryozoa: Flustrina) são conhecidas do Brasil, mas somente uma, identificada incorretamente na literatura como *B. intermedia* (Hincks 1881), é conhecida do Estado do Rio de Janeiro. Neste estudo, descrevemos três espécies de *Beania* de Arraial do Cabo, Estado do Rio de Janeiro: *Beania klugei* Cook, 1968 (= *B. intermedia sensu* Marcus, 1937), *Beania mirabilis* Johnston, 1840 e *Beania maxilladentata* sp.nov. *Beania mirabilis* Johnston, 1840 é um novo registro para a costa do Rio de Janeiro; é caracterizada por apresentar uma longa cauda basal, aproximadamente tão longa quanto o resto do autozoóide, um par de espinhos orais e usualmente cinco pares de curtos espinhos marginais arqueados sobre a membrana frontal. *Beania klugei* é caracterizada pela ausência de espinhos orais e marginais, por seus autozoóides grandes e pequenas aviculárias. *Beania maxilladentata* sp.nov. é caracterizada por autozoóides com até três pares de espinhos marginais dirigidos para o exterior; a extremidade distal do autozoóide nunca recobre o autozoóide subsequente; a aviculária é tão longa quanto larga e a mandíbula tem pontas acessórias. O número de espécies de *Beania* conhecidas aumentou de uma para três no Estado do Rio de Janeiro e de cinco para seis na costa brasileira.

Palavras-chave: Bryozoa. *Beania mirabilis*. *Beania klugei*. *Beania maxilladentata* sp.nov. Atlântico Sul.

INTRODUCTION

Beania Johnston, 1840 is the most speciose genus of the family Beaniidae (Cheilostomata, Flustrina), with approximately 60 species worldwide. It is widely distributed, being recorded from the Atlantic, Pacific, and Indian Oceans, from the Antarctic, and from the Mediterranean and Red Seas (e.g., WINSTON, 1982; COOK, 1985; LÓPEZ-GAPPA, 2001; TILBROOK *et*

al., 2001; FLORENCE *et al.*, 2007). The genus *Beania* is characterized by the reticulate or branched shape of the colonies, with autozooids joined by elongate proximal caudae (connective tubules) and attached to the substrate by basal radicles.

In Brazil, five species of *Beania* have been recorded: *B. australis* Busk, 1852; *B. hirtissima* (Heller, 1867); *B. mirabilis* Johnston, 1840; *B. intermedia* (Hincks, 1881); and *B. cupulariensis* Osburn, 1914.

¹ Submitted on June 18, 2007. Accepted on September 24, 2008.

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Of these, only *B. intermedia* has hitherto been recorded from Rio de Janeiro State; the other species were recorded from the São Paulo coast (MARCUS, 1937, 1939, 1944, 1949, 1955).

Twenty-four species of bryozoans have been previously described from Arraial do Cabo (RAMALHO *et al.*, 2005) and off Cabo Frio (BRAGA, 1967, 1968), in Rio de Janeiro State, none of which belong to *Beania*. Arraial do Cabo is a Marine Protected Area, the Extractive Reserve of Arraial do Cabo (ResEx), managed by the Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis (IBAMA – Brazilian Government), and a full inventory of species is of great importance for the management of this reserve. The aim of the current study is to

describe three species of *Beania* from Arraial do Cabo, one new to science and two new records for Rio de Janeiro State. A taxonomic key to the Brazilian species of *Beania* is provided.

MATERIAL AND METHODS

STUDY AREA

Arraial do Cabo (23°00'S, 42°00'W) is located 170km east of Rio de Janeiro (Fig.1). The coastal waters of Arraial do Cabo are strongly influenced by upwelling, principally from November to April when E-NE winds prevail (VALENTIN, 1984). Upwelling from the Central South Atlantic Waters (CSAW) is characterized by low

temperature (<18°C), salinity lower than 35.5 PSU, and high nutrient content (GONZALEZ-RODRIGUEZ *et al.*, 1992; VALENTIN & MONTEIRO-RIBAS, 1993). Apart from Anjos Beach, which has a harbour and a wave-break, and is characterized by low water circulation and pollution from oil (MURICY, 1989), the study area has high water circulation and generally unpolluted waters.

SAMPLING

Five sites were sampled in Arraial do Cabo: Forno Harbour (Anjos Beach), Fortaleza, Forno Beach, Pedra Vermelha, and Farol Beach (Fig.1). Samples were collected through SCUBA diving at depths of 0-10m between February 2000 and January 2004. Collecting was undertaken by two of us (L.V.R. and G.M.), together with David C.

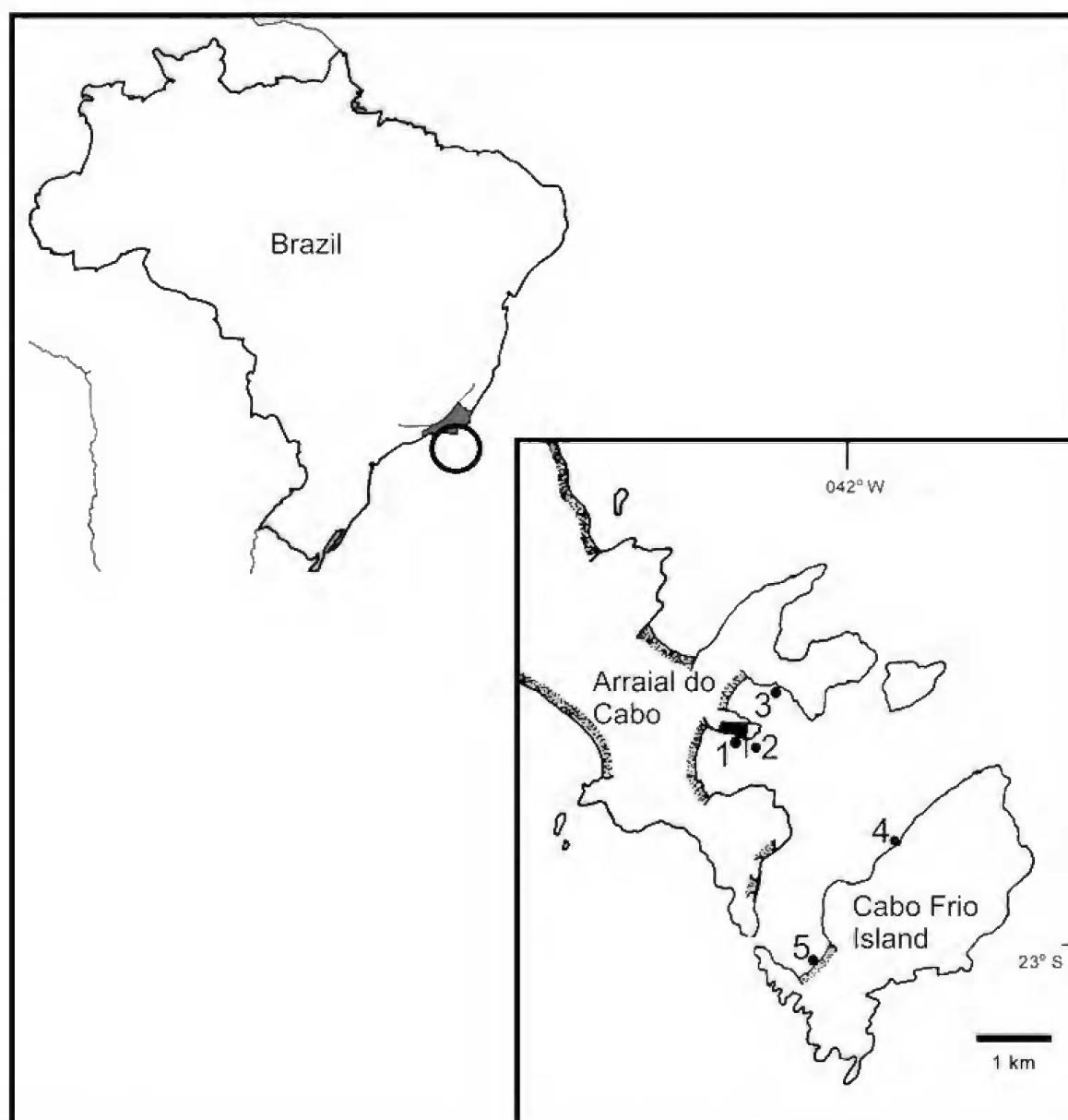


Fig.1- Map showing the location of Arraial do Cabo, Brazil, and the five sampling sites (inset): 1, Forno Harbour; 2, Fortaleza; 3, Forno Beach; 4, Pedra Vermelha; 5, Farol Beach.

Savi and Rodrigo Melo, from both natural (rocks, algae, coral, and hydroids) and artificial substrates (piers and experimental plates).

LABORATORY PROCEDURES

Specimens were fixed in 70% ethanol and have been deposited in the Bryozoan Collection of the Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ). Bryozoans were separated under a stereomicroscope, and characters such as autozoid length and width, avicularium length and width, and "connective tubule" length and width were measured. Measurements of the characters are shown as: Mean \pm SD (*B. mirabilis* N=17; *B. klugei* N=19, except avicularia with N=3; *B. maxilladentata* sp.nov. N=29, except avicularia with N=15). Camera-lucida drawings and photographs were made by light microscopy. Digital images were obtained of uncoated, dried specimens by using a low vacuum scanning electron microscope (LEO 1455VP) at the Natural History Museum, London (NHM).

RESULTS

Phylum Bryozoa Ehrenberg, 1831
Class Gymnolaemata Allman, 1856
Order Cheilostomata Busk, 1852
Suborder Flustrina Smitt, 1868
Family Beanidae Canu & Bassler, 1927
Genus *Beania* Johnston, 1840

Type species – *Beania mirabilis* Johnston, 1840.

Diagnosis – Colonies unilamellar, reptant or loosely encrusting, ramifying or reticulate, attached by rootlets issuing from basal surface, lightly calcified. Zooids uniserial, with elongated proximal caudae communicating via a multiporous septulum; frontal membrane extensive, occupying almost all distal frontal surface of zooid, usually surrounded by spines; ovicells present or absent. Avicularia often present, pedunculate, mandibles sometimes with accessory tips (modified from COOK, 1968, 1985; HAYWARD, 1995).

Beania klugei Cook, 1968
(Fig.2)

Beania klugei COOK, 1968:164.

Beania klugei, WINSTON, 1982:131; COOK, 1985:119; TILBROOK *et al.*, 2001:46.

Beania intermedia, HASTINGS, 1930:705 (part);

MARCUS, 1937:61, 1939:113, 1949:02; MATURO, 1966:579; ?KELMO *et al.*, 2004:614.
non Beania intermedia HINCKS, 1881.

Material examined – BRAZIL, RIO DE JANEIRO, Arraial do Cabo: Farol Beach, Cabo Frio Island, 4m depth, MNRJ-031, L.V.Ramalho coll., 13/II/2003; Forno Harbour (fishing quay), 6m depth, MNRJ-045, L.V.Ramalho and D.C.Savi coll., 31/VII/2003; Forno Harbour (fishing quay), 3m depth, MNRJ-046, L.V. Ramalho and D.C. Savi coll., 31/VII/2003. BRAZIL, SÃO PAULO STATE, Santos, NHM 1948.2.16.5, Marcus coll.

Material examined for comparison – *Beania klugei*: paratype: W. AFRICA, NHM 1974.1.18.1; Suez Canal, NHM 1926.9.6.133; NEW ZEALAND, NHM 1894.5.1.394 (labelled *Beania intermedia*).

Diagnosis – Colony uniserial. Autozooids without spines but with two minute distal prominences. Avicularia paired, very small, placed at either side of autozoid, level with operculum, beak shallow, elongate and downcurved. Lateral and rooting buds at the proximal end of the autozooids. Ovicells unknown (COOK, 1968).

Description – Colonies white, small, branched, attached to the substrate by radicles. Autozooids uniserially arranged, oblong, almost rectangular, longer than wide, the distal part dilated (length 0.98 ± 0.06 mm; width 0.30 ± 0.04 mm), the proximal part slightly elongate and narrow (length 0.15 ± 0.05 mm; width 0.08 ± 0.01 mm) (Fig.2). Walls lightly calcified. Frontal membrane occupies the entire frontal surface, allowing observation of internal structures such as polypide and muscles (Fig.2A). Two or four protuberances resembling small spines occur distally, above the operculum (Fig.2A). Marginal spines absent. Three small buds arise dorsally on each autozoid, producing new autozooids, one distally and two proximolaterally (Fig.2B, C). Radicles arise from the proximomedial bud (Fig.2B, C). Ovicells unknown.

A pair of small pedunculate avicularia (length 0.16 ± 0.02 mm) is usually present laterally of the orifice (Fig.2A, C, D), but may be absent or single. Beak short, slightly hooked at end. Mandible simple, strongly hooked (Fig.2D).

Ecology – Epibiont on filamentous algae and *Sargassum* spp., hydrozoans, and other bryozoans (*Catenicella* sp. and *Amathia* sp.), from 3-6m depth, in both polluted and unpolluted environments.

Distribution – RIO DE JANEIRO STATE: Arraial do

Cabo (Farol Beach and fishing quay of Forno Harbour; present study). BRAZIL: São Paulo, Rio de Janeiro and Pernambuco states (MARCUS, 1937, 1939, 1949 as *Beania intermedia*). In addition, KELMO *et al.* (2004) recorded what may be this species from Bahia

State under the name *Beania intermedia*. ELSEWHERE: Northwestern and southeastern Atlantic; southwestern Indian Ocean and Red Sea; southwestern Pacific (MATURO, 1966; COOK, 1968, 1985; WINSTON, 1982; TILBROOK *et al.*, 2001).

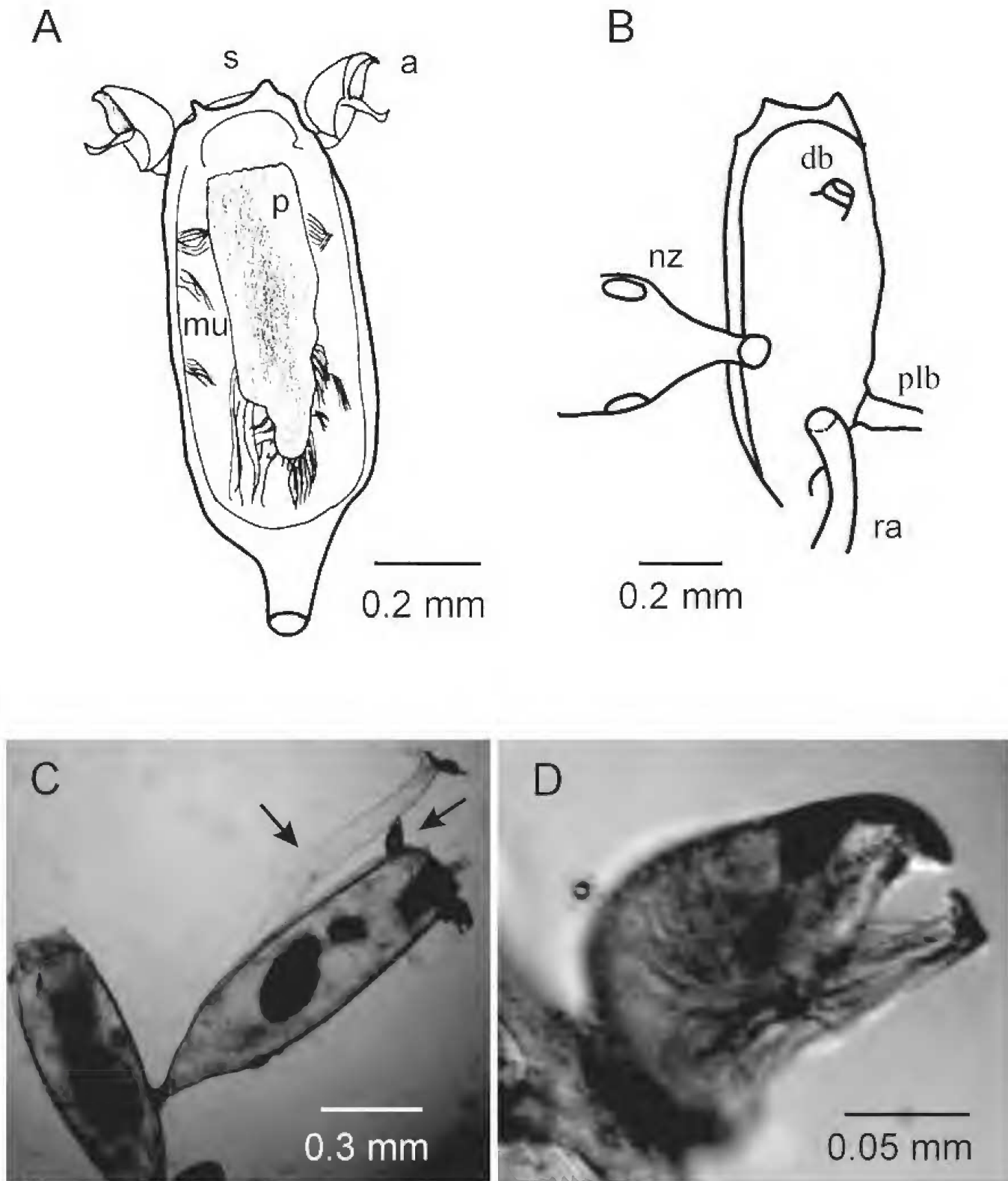


Fig.2- *Beania klugei* (MNRJ 046). A, frontal surface of an autozoid; a, avicularium; p, polypide; mu, muscle; s, spines; B, basal surface of an autozoid showing proximolateral buds (plb), distal buds (db), a new autozoid (nz), and a radicle (ra); C, colony with two autozooids showing avicularium and radicle (arrows); D, detail of an avicularium.

Remarks – *Beania klugei* is very similar to *B. intermedia*, from which it can be distinguished by the lack of marginal spines, larger autozooids, and smaller, more slender avicularia. Brazilian colonies of *B. klugei* are very similar in size to those described by COOK (1968) from West Africa and by TILBROOK *et al.* (2001) from Vanuatu (autozooid length 1.0mm, avicularium length 0.13-0.15mm). However, the Brazilian colonies differ from the material from Florida described by WINSTON (1982), which has smaller autozooids (0.73mm long). Other characters of the Brazilian colonies are very similar, especially to *B. klugei* from Suez Canal (NHM 1926.9.6.133) and West Africa (NHM 1974.1.18.1).

MARCUS (1937, 1939, 1949) reported *B. intermedia* from São Paulo, Rio de Janeiro and Pernambuco states. Re-examination of colonies from São Paulo State donated by Ernst Marcus to the Natural History Museum (NHM 1948.2.16.5) showed them lacking marginal spines and having small avicularia. Therefore, we conclude that *B. intermedia* sensu MARCUS (1937, 1939, 1949) is actually *B. klugei*.

Beania mirabilis Johnston, 1840
(Fig.3)

Beania mirabilis JOHNSTON, 1840:272.

Beania mirabilis, BUSK, 1852:32; ROBERTSON, 1905:276; HASTINGS, 1930:705; MARCUS, 1937:60; COOK, 1968:163, 1985:120; WINSTON, 1982:133; LÓPEZ-GAPPA, 2001:73.

Material examined – BRAZIL, RIO DE JANEIRO, Arraial do Cabo: Forno Harbour (salt quay), 6m depth, MNRJ-044, L.V.Ramalho coll., 07/IX/2003; Forno Harbour (fishing quay), 3m depth, MNRJ-086, L.V.Ramalho and D.C.Savi coll., 31/VII/2003.

Material examined for comparison – *Beania mirabilis*: ENGLAND, NHM 1897.5.1.400, Hastings coll.

Diagnosis – Colonies reptant or loosely encrusting, ramifying, attached by rootlets issuing from basal surface, lightly calcified. Zooids uniserial, connected by elongate proximal caudae; frontal membrane extensive, occupying almost all distal frontal surface of zooid; two pairs of oral spines plus five pairs of short spines usually present on the lateral margin overarch the frontal membrane. Ovicell unknown. Avicularia absent. (Modified from JOHNSTON, 1840).

Description – Colonies white, small (1cm), branching, attached by radicles.

Autozooids oblong, boat-shaped, more or less erect, longer than wide (length 0.71 ± 0.04 mm; width

0.19 ± 0.02 mm) (Fig.3A-C). Operculum approximately quadrangular and terminal. Polypide visible through frontal membrane. Frontal membrane flat and occupying the entire dilated frontal surface (Fig.3A, B). Two pairs of oral spines, one pair on the frontal corner and another pair on the basal corner (Fig.3C). Five pairs of short spines usually present on the lateral margin, overarch the frontal membrane (Fig.3B, C). Three buds occur, one basal and two proximo-lateral (Fig.3A-C); basal bud very long, approximately equal to one autozooid in length (length 0.67 ± 0.15 mm; width 0.07 ± 0.007 mm), and always producing a new autozooid (Fig.3B, C); lateral buds often give rise to radicles (Fig.3B-C). Ovicell unknown. Avicularia absent.

Ecology – Found as an epibiont on the bryozoans *Bugula dentata* and *Amathia* sp., filamentous algae, shells, and serpulids, from 3-6m depth, in a polluted environment (Forno Harbour).

Distribution – RIO DE JANEIRO STATE (new record): Forno Harbour, Arraial do Cabo (present study). BRAZIL: São Paulo (MARCUS, 1937) and Rio de Janeiro (present study). ELSEWHERE: North and South Atlantic, Mediterranean Sea, northeastern and southern Indian Ocean; northeastern Pacific (BUSK, 1852; ROBERTSON, 1905; HASTINGS, 1930; MARCUS, 1937; COOK, 1968, 1985; WINSTON, 1982; LÓPEZ-GAPPA, 2001).

Remarks – *Beania mirabilis* resembles *B. australis* Busk, 1852 from which it can be distinguished by the number and length of the spines. *Beania australis* has 34 to 44 long and thick spines that overarch and meet above the frontal membrane. In *B. mirabilis* the spines are shorter and less numerous, overarch the frontal membrane but not meeting one another.

TILBROOK *et al.* (2001) redescribed Johnston's type material of *B. mirabilis*, giving the following dimensions: NHM 1847.9.18.91 – autozooid length 0.70mm long, 9-10 pairs of spines; NHM 1847.10.11.43 – autozooid length 0.70 ± 0.06 mm long, 2-6 pairs of spines. Brazilian specimens are very similar to these specimens in both qualitative and quantitative aspects, but have fewer spines. However, spine number seems to be highly variable; other authors also have observed variations in spine number: 8-12 spines (HARMER, 1926), 10 spines (MARCUS, 1937), 10-22 spines (WINSTON, 1982), 12-22 spines (COOK, 1985), 12-16 spines (LÓPEZ-GAPPA, 2001), and 14 spines (NHM 1897.5.1.400). As the number of spines in the Brazilian specimens falls within this overall range, we feel confident in assigning these specimens to *B. mirabilis*.

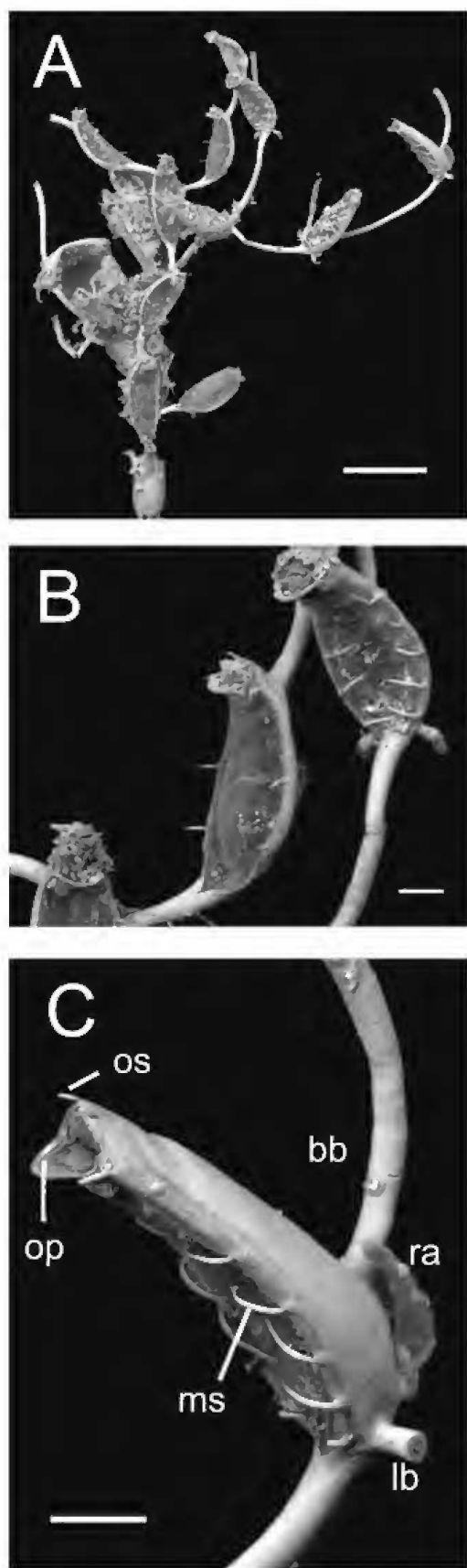


Fig.3- *Beania mirabilis* (MNRJ 086; SEM). A, general view of a colony; B, frontal view of autozooids showing frontal surface with marginal spines and basal and lateral buds; C, frontal-lateral view of an autozoid showing basal and lateral buds (bb and lb), radicle (ra), oral and marginal spines (os and ms) and operculum opened (op). Scale bars: A = 600 μ m; B and C = 100 μ m.

Beania maxilladentata sp.nov.
(Fig.4)

Material examined – BRAZIL, RIO DE JANEIRO, Arraial do Cabo: Holotype: Forno Harbour (fishing quay), 6m depth, MNRJ-049, L.V.Ramalho and D.C.Savi coll., 31/VII/2003. Paratypes: Forno Harbour (fishing quay), 6m depth, MNRJ-028, L.V.Ramalho and D.C.Savi coll., 11/X/2002; Pedra Vermelha, Cabo Frio Island, 5m depth, MNRJ-029, L.V.Ramalho and R.Melo coll., 27/II/2003; Farol Beach, Cabo Frio Island, 5m depth, MNRJ-030, L.V.Ramalho coll., 1/II/2000; Forno Harbour (fishing quay), 3m depth, MNRJ-047, L.V.Ramalho and D.C.Savi coll., 31/VII/2003; Forno Harbour (wave-break), 5m depth, MNRJ-048, L.V.Ramalho coll., 6/IX/2003.

Diagnosis – Colony attached by radicles, branched. Autozooids with up to three pairs of marginal spines directed outwardly; distal ends of autozooids never overlapping next zooid in series. Avicularia as long as wide, mandible with accessory tip. Ovicells unknown.

Etymology – The name *maxilladentata* refers to the mandible with teeth (*maxilla*: mandible; *dentatus*: which have teeth).

Description – Colonies white, small, branched, attached by radicles. Autozooids uniserially arranged, oblong, narrow, longer than wide (length 0.97 ± 0.07 mm; width 0.24 ± 0.03 mm). One to three pairs of short marginal spines originating outside rim of opesia, the most proximal pair always directed outwards and the other two pairs directed upwards or outwards but never overarching the frontal membrane (Fig.4A). One or two pairs of short oral spines on distal margin, directed upwards; in the absence of avicularia, four oral spines equidistantly spaced along the oral margin; the most proximal spines are located at the same position as the avicularium and lacking when an avicularium is present (Fig.4A). Frontal membrane flat, occupying the entire frontal dilated surface (Fig.4A). Four lightly calcified, long buds (length 0.26 ± 0.04 mm; width 0.08 ± 0.01 mm) per autozoid: one distal, two laterals and one proximomedial (Fig.4A, B). New autozooids formed from the distal and lateral buds; radicles arise from the proximomedial bud and perhaps also the lateral buds (Fig.4B). Lateral buds occur in two patterns: either both are situated proximally and opposite one another (Fig.4A), or one is proximal and the other distal (Fig.4B). Ovicells unknown.

Avicularium pedunculate, dome-like, as long as wide

(length 0.14 ± 0.02 mm), attached to autozoid distally, located laterally to the operculum, occupying the same position as the proximal oral spines (Fig. 4A, B, C). Avicularia numbering one, two or absent altogether (Fig. 4A, B, C). Beak strongly curved; mandible with one or two tooth-like, accessory tips (Fig. 4D).

Ecology – Found as an epibiont on the bryozoans *Scrupocellaria* sp. and *Amathia* sp., shells, serpulids, filamentous algae, and *Sargassum* sp.; depth 3-6m.

Distribution – RIO DE JANEIRO STATE: Arraial do Cabo (Forno Harbour, Forno Beach, Pedra Vermelha, and Farol Beach). BRAZIL: Rio de Janeiro State (present study). ELSEWHERE: Endemic from Rio de Janeiro State (present study).

Remarks – *Beania maxilladentata* sp. nov. is similar to *B. cupulariensis* (Osburn, 1914), *B. intermedia*, and *B. cookae* (Tilbrook *et al.*, 2001). *Beania cookae* differs in having only three buds, larger autozooids, and avicularian mandibles without accessory tips.

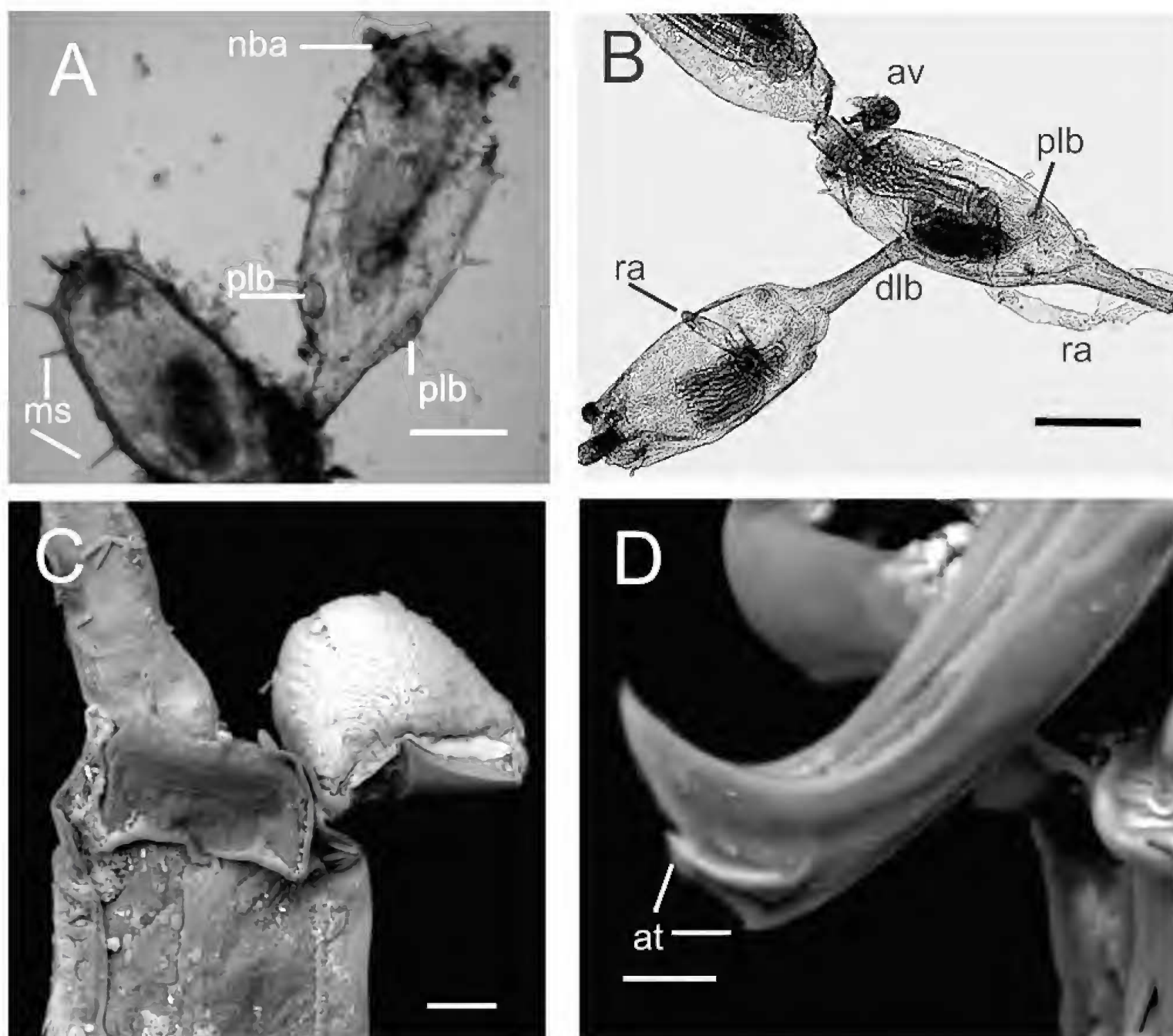


Fig. 4- *Beania maxilladentata*, sp. nov. (MNRJ 029). A, basal surface of a colony showing proximolateral buds (plb), new born avicularia (nba) and marginal spines (ms); B, general view (basal surface) of a colony with three autozooids showing an avicularium (av), proximolateral buds (plb), distolateral bud (dlb), and radicle (ra); C, distal view of an autozoid with an avicularium; D, detail of avicularium mandible showing accessory tips (at). C-D, SEM. Scale bars: A = 300 μ m; B = 400 μ m; C = 40 μ m; D = 10 μ m.

In the number and position of the connective tubules and the number of marginal spines, *B. maxilladentata* sp.nov. resembles *B. intermedia* (e.g. NHM 1894.5.1.394, New Zealand). However, the avicularian beak is scarcely bent and the mandible is straight, while oral spine number is higher in *B. intermedia*. The new species seems to be most similar to *B. cupulariensis* (e.g. NHM 1931.12.19.1, Tortugas; NHM 1928.3.6.251, Malay Archipelago) which also has accessory tips on the avicularian mandibles, although the original description and drawings of *B. cupulariensis* do not mention this feature (OSBURN, 1914). Two specimens identified as *B. cupulariensis* by HARMER (1926) and MARCUS (1955) show avicularia with accessory tips but the shape is wider than long and the beak is not as bent. In contrast, *B. maxilladentata* sp.nov. has an avicularium as long as wide with a strongly bent beak. Furthermore, the marginal spines (4-6 pairs) in *B. cupulariensis* are more numerous and overarch the frontal membrane, with only the most proximal pair directed outwards. In *B. maxilladentata* sp.nov. all spines are directed outwards and never overarch the frontal membrane. Another difference is that the caudae in *B. cupulariensis* are so short that the distal end of the autozoid overlaps the proximal end of the next autozoid in series, making the colony more compact, whereas the caudae are longer and the colonies more diffuse in the new species.

DISCUSSION

The presence of accessory tips in the avicularia of *Beania* has rarely been discussed in the literature, and only MARCUS (1955) mentioned its importance

in the identification of *B. cupulariensis*. HARMER (1926) drew an avicularium with an accessory tip in this same species but made no comment in his description. The presence of this character in some species should be added to the diagnosis of the genus *Beania*. The function of the accessory tips remains to be established.

We have described here three species of *Beania* from Arraial do Cabo: *B. klugei*, *B. mirabilis* and *B. maxilladentata* sp.nov. *Beania klugei* was previously recorded from São Paulo, Rio de Janeiro, and Pernambuco states by MARCUS (1937, 1939, 1949) as *B. intermedia*, and may also occur in Bahia State (KELMO *et al.*, 2004). *Beania mirabilis* is a new record for Rio de Janeiro State; it was previously known in Brazil only in São Paulo State (MARCUS, 1937). Thus, the valid species of *Beania* from Brazil are: *B. klugei*, *B. mirabilis*, *B. maxilladentata* sp.nov., *B. australis*, *B. hirtissima*, and *B. cupulariensis*. With these new findings, the number of species of *Beania* in Rio de Janeiro State increases from one to three, compared with the six species of *Beania* now known from the Brazilian coast as a whole (MARCUS, 1937, 1944, 1949; present study).

The total number of *Beania* species now known from Brazil probably does not represent the true diversity of this genus there because colonies are very difficult to find and collect. Despite a considerable volume of work by MARCUS (1937, 1955) along the Brazilian coast, knowledge of the bryozoan fauna in Brazil remains fragmentary and highly incomplete, as in many other parts of the world. New taxonomic research is needed before the diversity and distribution of *Beania* in Brazil can be fully established.

KEY TO THE BRAZILIAN SPECIES OF *BEANIA*

- 1A. Autozooids without marginal or distal spines; one pair of distal avicularia *Beania klugei*
- 1B. Autozooids with marginal or distal spines 2
- 2A. Autozooids with short marginal spines, covering the frontal membrane or directed outwards; avicularia can be present 3
- 2B. Autozooids with long marginal spines, covering the frontal membrane; avicularia absent 5
- 3A. One pair of distal avicularia; mandible of the avicularia with accessory tips 4
- 3B. Avicularia absent. Autozooids with 5-11 pairs of marginal spines and two pairs of distal spines; cauda is approximately the length of the rest of the autozoid *Beania mirabilis*
- 4A. Autozooids with up to three pairs of marginal spines, directed outwards or upwards, but never arching over the frontal membrane *Beania maxilladentata* sp.nov.
- 4B. Autozooids with four to six pairs of short marginal spines arching over the frontal membrane, the most proximal pair directed outwards; caudae short, distal end of one autozoid covering the proximal end of the next autozoid *Beania cupulariensis*

- 5A. Autozooids with 17 to 22 pairs of long, thick marginal spines covering the frontal membrane, sometimes meeting or crossing the median line; up to three pairs of short, thick distal spines *Beania australis*
- 5B. Autozooids with five to 12 pairs of long marginal spines, covering the frontal membrane; approximately 10 long distal spines, directed outwards; variable number of slender, simple, bi- or trifurcate spines on the basal wall *Beania hirtissima*

ACKNOWLEDGEMENTS

We thank PETROBRAS (Petróleo Brasileiro S.A.) for a scholarship to L.V.R., and the “Instituto de Estudos do Mar Almirante Paulo Moreira” for infrastructure and equipment. Mary E. Spencer Jones (NHM, London) is thanked for assistance with type and reference material. David C. Savi and Rodrigo Melo (“Instituto de Estudos do Mar Almirante Paulo Moreira”, Arraial do Cabo) are thanked for help during SCUBA diving. Mirna F. Alencar assisted with the English first draft of the manuscript. Financial support was given by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), and Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ).

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